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AND

TREATMENT.

BY

BERNARD E. BRODHURST, F.R.C.S.,

OF ST. GEORGE'S HOSPITAL AND THE ROYAL ORTHOPÆDIC HOSPITAL; HONORARY SURGEON TO
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TO HIS COLLEAGUES,

THE PHYSICIANS AND SURGEONS

OF

ST. GEORGE'S HOSPITAL,

IN ACKNOWLEDGMENT OF MUCH KINDNESS, WHICH WILL EVER BE
REMEMBERED WITH GRATITUDE,

AND

IN PROOF OF HIS DESIRE TO EMULATE THEIR LABOURS FOR THE
ADVANCEMENT OF MEDICAL SCIENCE,

THIS TREATISE IS DEDICATED

BY THE AUTHOR.

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PREFACE.

THE subject of Spinal Curvatures has not perhaps received all that attention which it deserves. Sir Benjamin Brodie, in a lecture which he delivered at St. George's Hospital, in 1846, for instance, says, "When I first became engaged in a considerable private practice, and cases of Curvature of the Spine were presented to my observation, I was in doubt as to their nature and treatment. I knew nothing of them from my own experience, and I had learned nothing of them from my teachers. I felt that in this respect my education had been imperfect, and it took me no small trouble to supply the deficiency. Your situation," continued Sir Benjamin, "in this respect is probably not very different from what mine was formerly." This is a sad reproach, and yet I would ask, has anything been done to remove it. Has the student of 1864 opportunities of studying these affections which were not enjoyed at the time Sir Benjamin Brodie was speaking? I fear it must be said at the present day, as it was said twenty years ago, "that the hospital (and hospitals in general) will not afford the information which we stand in need of." Should this work be useful in teaching something of the nature and treatment of spinal curvatures, I shall be well pleased to have spent time in writing it.

This Second Edition has been entirely re-written; it has been much enlarged, and all the woodcuts are new. I am indebted to Mr. Bagg for the great care and accuracy with which he has made the drawings. They were made with the *camera lucida*, and show very truly and exactly what they are intended to illustrate. I am also indebted to my friend Mr. Wheeler, of Bexley, for permission to use several very important pathological specimens in illustration of the subject.

Throughout it has been my endeavour to adhere as strictly to truth as possible. I have desired not to exaggerate the importance of my subject, and yet to state it so fully as to call attention to a class of diseases which is at present neglected. No one can be better aware than I am of the imperfections of this volume; but if my professional brethren will give me credit for a sense of duty in its preparation, and will accord to this Edition not less favour than to the first, I shall be well rewarded.

20, GROSVENOR STREET;
October, 1864.

CURVATURES OF THE SPINE.

INTRODUCTION.

Curvatures of the spine differ extremely, both in appearance and in form. They are chiefly met with in the forms which are known as anterior curvature (*lordosis*), posterior curvature (*cyphosis*), and lateral curvature (*scoliosis*).

These terms, lordosis, cyphosis, and scoliosis, have been applied to curvatures of the spine ever since the time of Hippocrates. They were not used then, however, exactly in the same sense as they are now understood; for the term scoliosis, which now signifies lateral curvature of the spine, was then frequently applied indiscriminately to every form of spinal distortion.

The antero-posterior pathological curves are, for the most part, merely exaggerated conditions of the physiological curves: thus we find lordosis existing especially in the lumbar region, and cyphosis in the dorsal region. It will be shown farther on, however, that these conditions are not absolutely limited to a given region; but that the vertebræ above and below may be involved in the curve, so as to reverse the normal curve of any region. These curves are rarely congenital; but they are for the most part induced through ignorance or neglect on the part of the nurse, or otherwise through deficient nutrition.

Before proceeding to consider these pathological conditions, however, it may be advantageous to glance at the normal—physiological—curves of the spinal column, as they occur in the *fœtus in utero,* after birth, and in the adult; and to consider very briefly their formation and their purposes.

NORMAL, OR PHYSIOLOGICAL ANTERO-POSTERIOR SPINAL CURVES.

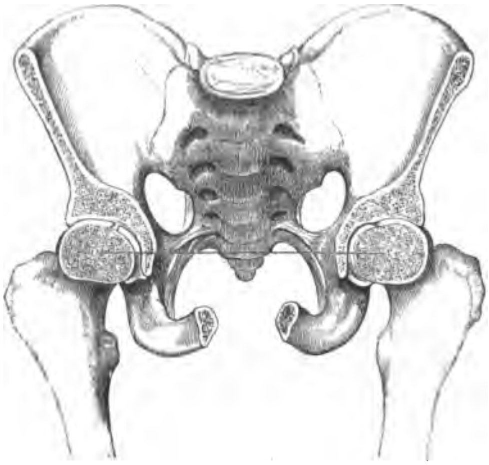
The spine in the fœtus is bent forwards; its curve being moulded by the walls of the uterus: the head is bent upon the breast, and the thighs are folded upon the abdomen.

In the infant, the spine remains almost straight while in the horizontal position. The sacrum is only slightly curved, and the pelvis is more oblique than in the adult.

The normal—antero-posterior—curves are developed slowly, and depend in great measure on muscular action, and on the erect position which man is destined to assume. At birth these curves do not exist; and even in the young child they are not constant, for they disappear when the horizontal position is resumed. Gradually, however, the antero-posterior curves become more or less permanent; and, before growth is complete, the spine is found to have gained, as a constant condition, lumbar, dorsal, and cervical curves; while, on the other hand, it has lost much of its flexibility.

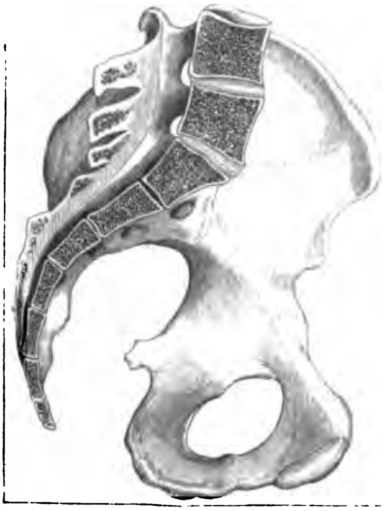
On examining carefully the spinal column of the adult in the erect position, it will be seen that the base of the sacrum is so placed that it is to be found immediately above a straight line which may be supposed to pass through the heads of the thigh-bones, and which is known as the interfemoral line. It is shown in the following figure (Figure 1). This fact was demonstrated by MM. Weber.

FIG. 1.



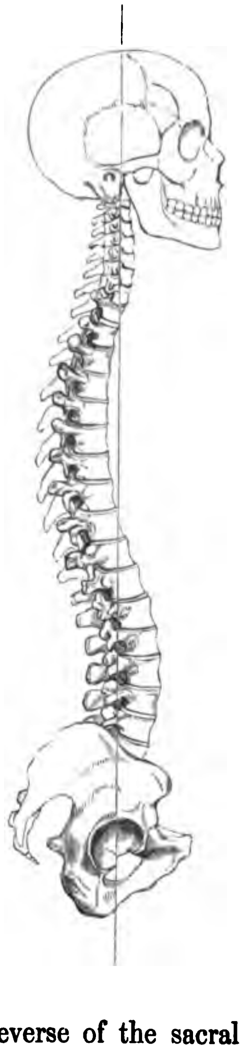
Naegele first showed exactly the position of the pelvis in the upright posture. Before he demonstrated the fact, it was believed that the pelvis was more horizontal than is absolutely the case. The pelvis is so oblique that the anterior wall (pubes) presents upwards and backwards, and the posterior wall (sacrum and coccyx) downwards and forwards, as is shown in Figure 2. Such, then, being the positions of the pelvis and the sacro-lumbar articulation, the question arises, how is equilibrium maintained?

FIG. 2.



Equilibrium is the result of certain forces acting in front of, and behind, the spinal column; namely, the action of the flexors and the extensors of the trunk, neck and head, and the resistance of the ligaments that hold together the several vertebræ which form the spinal column. In the erect posture these structures combine to poise the head and the vertebral column in the vertical line on the heads of the thigh-bones. (See Figure 3.)

FIG. 3.



In considering this question, the weight of the viscera should not be forgotten. In this place, however, the chief points only will be considered.

The position of the sacro-vertebral articulation being, then, such as has been described, it becomes necessary for the maintenance of equilibrium, and that the head may be poised (its centre of gravity corresponding with a vertical line which coincides with the axis of the trunk, and which shall fall on the interfemoral line), *first, that the lumbar vertebræ shall be curved backwards.* This lumbar curve is the result of muscular action in the endeavour to maintain the erect position. It is the reverse of the sacral curve; and it springs from the sacro-lumbar articulation upwards and backwards, the sacral curve commencing at the same articulation, and presenting downwards and forwards. But the lumbar curve having been formed, it is essential that a second curve—the dorsal—shall restore the direction of the spine towards the perpendicular line; and, for a similar reason, the cervical curve is formed in the same direction as the lumbar curve. These several portions of the spine differ somewhat in flexibility, the lumbar and dorsal portions possessing this quality very nearly in equal degrees; but in the cervical region the flexibility is three times that of either of the former. A structure is thus composed of segments of various circles, strong, yet elastic, fitted to bear the superincumbent weight, and to resist the effects of shock.

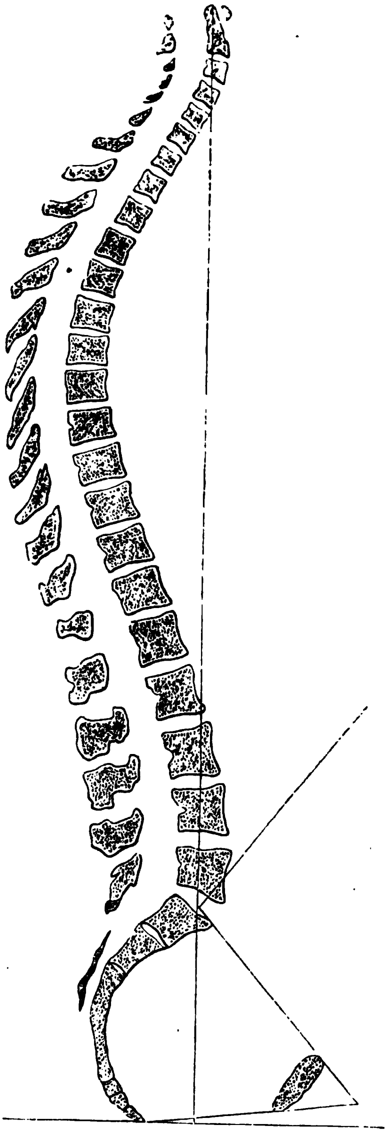
It would, perhaps, be impossible to imagine a structure more perfectly adapted to its purposes than the spinal column, formed as it is of separate pieces, severally united by discs of fibro-cartilage, bound together by numerous and strong ligaments, and surrounded and acted on by powerful muscles. Its flexibility and its curved form are points of even more importance than its great strength: these adapt the spine specially to its purposes.

Not to enter too minutely into questions of physiology, I would only allude to the opinions of some eminent physiologists, as the Webers, Cruveilhier, Bishop, and others, who have stated their belief that the normal curves of the spine depend on varying thicknesses of the bodies of the vertebræ and the intervertebral substances. It is true, as the Webers have shown, that, in the dorsal region of the spine especially, differences exist on the anterior and the posterior surfaces of the vertebræ; namely, that on their anterior surfaces, in the concavity of the curve, they are somewhat thinner than posteriorly; while in the lumbar and cervical regions the fibro-cartilages are especially affected, being compressed posteriorly.

To show the varying thicknesses of the anterior and the posterior surfaces of the vertebræ and the intervertebral cartilages, the Webers caused the spine to be bisected in the mesial plane, the viscera having been removed from the cavities of the thorax and abdomen, and their spaces having been filled with liquid plaster of Paris. The relative normal positions of the various portions of the spinal column were thus obtained, and from the section the accompanying figure (Figure 4) was taken, which represents most accurately the forms of the several curves and the proportions of the bones and cartilages which together constitute the spinal column.

But it has been already shown that the physiological — antero-posterior — curves do not exist at birth; and that, when first observed, they are not permanent, but are lost in the horizontal posture. Further, these inequalities in the vertebræ and the intervertebral substances do not exist at birth, nor are they found until the spinal curves commence to be permanent. Also, they increase with age. Such being the case, it follows as a necessary consequence that these differences in the anterior and posterior surfaces of the bodies of the vertebræ, and especially of the fibro-cartilages, are due to the antero-posterior curves, are due, in fact, to the erect position and to the

FIG. 4.



pressure from above downwards consequent on that position.

The effect of pressure on the intervertebral cartilages is shown by the loss of height which is sustained at the end of the day. Thus it is well known that a man of middle stature, who remains in the erect posture during the day, will lose nearly one inch in height, and that this will only be regained after he has been in the recumbent position for six or eight hours. It is only logical, therefore, to conclude that these varying thicknesses of the bodies of the vertebræ and of the intervertebral substances are produced by pressure as a result of the erect position, and that they would never be developed any more than the antero-posterior curves themselves, in the horizontal position.

It may, then, be stated that the antero-posterior curves of the spinal column result as a consequence of the erect position and from muscular action in maintaining equilibrium, and that unequal pressure occasions thinning of the bodies of the vertebræ and of the intervertebral substances in the concavities of the curves. This view will be confirmed by the consideration of pathological curves.

PATHOLOGICAL SPINAL CURVES.

SECTION I.

ANTERIOR CURVATURE OF THE SPINE.

General Description.

LORDOSIS, or anterior curvature of the spine, affects, for the most part, the lumbar region, it being an abnormal increase of the physiological curve of that region.

In the cervical region a similar abnormality is occasionally found to exist as a primary condition. Here it is transitory, however, occurring in infants, and being due to want of muscular power.

In the lumbar region this distortion varies from a slight increase of the normal curve to a development which is a source of great weakness. The normal condition has already been shown. Through increase of this curve the obliquity of the pelvis is augmented, the anterior wall being carried backwards, and the sacrum and coccyx being raised, so that their concavities present more directly downwards, the superior portion of the pelvis inclining forwards or moving on the heads of the thigh-bones. The sacro-lumbar articulation, consequently, is no longer found immediately above the interfemoral line, but in advance of that line. Equilibrium is disturbed; and that it may be restored it is necessary that the weight of the upper part of the trunk be thrown behind the vertical line of the body, and thus a compensatory antero-posterior dorsal curve is induced.

Symptoms.

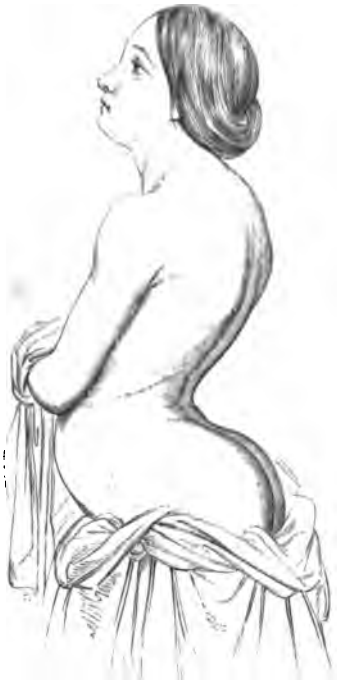
The *external appearances* presented by this distortion, then, are such as are indicated by the changes in the skeleton above mentioned. They are well represented in Figure 5. The nates are raised; the lumbar region is rendered remarkably hollow; while the dorsal is rounded, and the head is thrown back. The abdomen is unusually prominent; the stature is necessarily stunted. When the distortion occurs in childhood growth is impeded, and when it takes place in the adult much loss of height is induced.

Causes.

The causes of lordosis are numerous. As a congenital affection it is combined with monstrosity and with spina bifida. In childhood this distortion is often observed as a result of rickets.

An hereditary disposition to lordosis is also sometimes observed; one or more members of a family being affected. It may be the only sign of a rachitic tendency, or a more severe and general form of rachitic affection may present itself. In some members the cachexia is so marked that the whole skeleton partakes, and no por-

FIG. 5.



The drawing from which the woodcut is made, was taken from a young person in whom rickets was the cause of distortion.

tion of it remains unaffected. When the pelvis is much contracted and anterior spinal curvature is at the same time considerably developed, natural parturition may be prevented, and the Cæsarean section, or other such means, may become necessary for the removal of the fœtus. Such instances are recorded by Ramsbotham, Kilian, and others. In these cases softening of the bone had allowed excessive distortion to be produced; but it is inaccurate to describe this distortion as dislocation. It is not possible, even in extreme instances of distortion, that dislocation of the lumbar vertebræ shall be produced in these cases. The instances of distortion which have been thought by some to be dislocations, have been proved to be rachitic distortions, both by the positions of the spinous processes, and by the general conformation of the trunk.

Whatever tends to increase the obliquity of the pelvis will give rise to this form of distortion. Thus, it is a necessary consequence of congenital dislocation of the heads of the thigh-bones (upwards and outwards). In some instances arising from this cause the distortion is very remarkable. A child is at the present time under my care for congenital dislocation of the thigh-bones, in whom lordosis was very marked; so much so, indeed, was it, that the congenital dislocation had been entirely overlooked, and attention had been directed to the spinal curvature alone—a result only of the dislocation.

Lordosis may be induced equally by unreduced non-congenital dislocation of the thigh-bones. Thus, it exists in a very marked degree in a young man, twenty years of age, who has suffered successively in each hip-joint with rheumatic inflammation and subsequent dislocation on to the dorsum ilii, and whom I lately had occasion to see; in whom it was impossible, notwithstanding every care, to arrest the disease. In these cases, as in those last mentioned, great efforts are made to sustain equilibrium; the extensor muscles of the trunk are tense and prominent, and, standing out firmly, they leave, especially towards the lower part of the spine, a deep sulcus in the median line.

I lately saw, together with Mr. Brookes, a similar form of distortion arising from a totally different cause, at Shaldon, in Devonshire; and I allude to the case, not because it is one commonly to be met with, but because it is exceedingly rare. Fatty degeneration of the muscles of the abdomen having occurred, the abdominal viscera hung suspended in a huge, tumid paunch; the weight of which had, in part, occasioned the distortion in question. This distortion was one of the most remarkable that I ever witnessed. The effect was increased, also, by fatty degeneration of many other muscles, such as the trapezii, rhomboidei, serrati, latissimus dorsi, the pectoral muscles, and those of the lower extremities. Many of these muscles were so far destroyed that they could not even be traced. In this instance, the unsupported pendulous belly, together with the loss of muscular power, seemed to give rise to lordosis, in a somewhat similar manner to that in which the gravid uterus is sometimes known to act.

Bearing heavy weights round the neck and shoulders will also occasion lordosis. That a considerable burden may thus be slung, borne upon the neck and shoulders and suspended in front, it is necessary that the shoulders shall be thrown back, and that, consequently, the loins shall be projected forwards. If this practice is continued, the increased lumbar curve becomes more or less permanent. I have also known gymnastic exercises to produce a somewhat similar result.

Pathological Anatomy.

The pathological changes which are induced are chiefly as follow. The lumbar spines are approximated; the articulating processes of the vertebræ are pressed forcibly into contact one with another; the posterior ligaments become somewhat shortened, and the ligamenta subflava lose something of their elasticity; the bodies of the vertebræ undergo absorption, and the intervertebral substances are compressed posteriorly; while expansion of these substances takes place on the anterior surface in the convexity of the curve. The extensor muscles of the trunk are strongly developed. Ankylosis of the articular processes of the vertebræ, with or without fusion of the bodies, may at last take place, through which the spine is rendered immovable and the distortion permanent.

Anterior curvature is, for the most part, limited to the lumbar region of the spine; the dorsal and sacral regions being implicated only so far that their normal curves become exaggerated. Occasionally, however, some few of the lower dorsal vertebræ may become involved, together with the lumbar curve; or, indeed, the entire dorsal curve may be reversed, and the anterior curvature will then consist of the lumbar vertebræ together with the dorsal. This is, necessarily, a very rare form of distortion, and it indicates great weakness of the muscles and ligaments of the spine. In an instance which I lately saw the sacrum was almost horizontal, and the head was forcibly thrown back.

Treatment.

It has already been said that lordosis is seldom a primary affection, but that it is the result of disease, or that it arises from the position of parts which are entirely independent of the lumbar region itself. It is for the most part developed in childhood; and at this early period it disappears in the horizontal position, let the cause of the affection be what it may other than rachitis. This rule is sufficient for practical purposes. To rickets, however, should be added other very rare forms of this affection; namely, those which are due to monstrosity, and to deficiency or excess in formation of the bodies of the vertebræ. It is not necessary to say, however, that the cause remaining, the effect will return, and that, therefore, it is of the utmost importance to discover and remove the cause. This may be said of every disease; but it is especially true of every form of spinal curvature.

The treatment of lordosis is the treatment, in the horizontal position, of the several affections which give rise to it. With a properly inclined couch (having a hinge to correspond to the pelvis), the prone position may be observed. The supine position is more effectual, however, for the removal of lordosis: by gradually raising the shoulders and flexing the thighs upon the pelvis, cyphosis even may be substituted for lordosis.

Gymnastic exercises may be employed with advantage when the curve is slight; and the form of exercise which is most beneficial is that which is indicated by Andry, who said: "Si la taille fait un creux, en sorte que l'épine soit courbée en dedans, ce qui est le contraire de la bosse du dos, faites souvent courber l'enfant. Jettez-lui pour cela des cartes ou des épingles sur le plancher, il se fera pun laisir de les ramasser. La situation qu'il sera obligé de prendre pour en venir à bout, contraindra, à la longue, l'endroit creux de son épine à revenir en devant."*

The same exercise is better accomplished by means of elastic bands, the handles of which are fixed near to the floor, so that in using them the same movements must be accomplished (only with more regularity and more continuously) as in the mode indicated by Andry. Exercises, however, should be used sparingly and with great care. They are only admissible when distortion is slight: when it is severe they should be entirely prohibited.

The recumbent position is the most powerful means we possess for the removal of lordosis: the muscles of the back are then relaxed, the normal spinal curves are then in part effaced, and cyphosis even may be induced if this position be long continued. In the rachitic form of distortion the recumbent position is especially to be insisted on. Sitting or standing necessarily tend to increase the curve. And, as we know well, when the lower extremities are affected at the same time as the spinal column, the weight of the body falling upon them will necessarily increase the deformity. The recumbent position is, then, in these cases of the first importance. When this is strictly observed, treatment may be effectually pursued, whether the spine is alone affected, or the long bones together with it. And I do not even recommend muscular exercises whilst this position is maintained, except it be what are known as Swedish gymnastics.

---

* 'L'Orthopédie.'

The influence of the muscles in distorting the arms and forearms is well understood, and therefore active exercises ought to be forbidden in every severe case of rickets. Passive movements of the limbs, when they are practised gently, are, I believe, beneficial, both locally and generally: the muscles no longer dwindle, and the circulation is accelerated.

Patients who are thus affected require especially to breathe the open air. As much as possible a dry, pure atmosphere should be selected for them. The disease may often be observed to stop when the patient is removed to a suitable locality, whether on the sea-coast, or into pure air away from a town; and, on the other hand, it will again increase rapidly when he is pent up in a hot, ill-ventilated room. The same may also be said of growth. I have known growth to be rapid on placing a patient in advantageous circumstances, in cases where it had been entirely arrested during many previous months; and on restoring the former conditions, I have known it again to be checked. As the general health improves, assimilation becomes more perfect, and thus not only is disease arrested, but consolidation takes place. This, also, is promoted by insisting on an animal diet being adhered to as much as possible. Meat and milk should be the staple food of all rachitic patients. From these are deposited those earthy portions of the bones which we are desirous to see formed. And, for a similar reason, cod-liver oil may be given. It is food in the most easily digestible condition. When, however, it causes sickness or diarrhœa, or when it interferes with a healthy appetite for solid meat, it ought to be discontinued. Preparations of iron are generally beneficial. Perhaps that which is the least useful is steel wine.

In concluding this chapter I would mention, with regard to stimulants, that they are, for the most part, injurious in these affections. Generally, they tend to increase the night perspirations. If, however, in small quantities they appear to increase the appetite they may be given, but their effect requires always to be carefully watched.

Cases occur, however, in which it is not practicable to observe constantly the recumbent position, and it then becomes necessary to substitute for it a portable instrument, which, receiving the weight of the head and shoulders, transmits it to the pelvis. The spinal column is thus relieved, and the extensor muscles are less violently thrown into action. It is a very imperfect substitute, however, for the recumbent position.

The treatment of that form of lordosis which is induced by congenital dislocation of the femur is simply the treatment of the dislocation itself, of which I have written elsewhere.* Also, those consecutive curves which are found to restore and which help to maintain the equilibrium of the body, such as are occasioned by the distortion consequent on caries of the bodies of the vertebræ, and on ankylosis of the hip, for instance, require little more attention than such aid as is afforded by a well adjusted support.

---

* 'Holmes' System of Surgery,' vol. iv.

PATHOLOGICAL SPINAL CURVES.

SECTION II.

POSTERIOR CURVATURE OF THE SPINE.

General Description.

CYPHOSIS, or posterior curvature of the spine, is a much more frequent affection than the last-mentioned form of distortion. Occurring as it does, indeed, in infancy, in youth, and in old age, it is one of the most common forms of distortion of the spinal column. As well as being applied to posterior curvature, the term cyphosis is also sometimes used to express angular curvature of the spine. But inasmuch as posterior curvature and caries, or angular curvature, are totally distinct affections, I shall not include them under a common heading; nor shall I further allude to the last-mentioned form of disease at the present time, but shall reserve what I have to say with regard to it for a future occasion.

Causes.

The causes of posterior curvature of the spine are debility—whether in infancy, in youth, or in old age; rachitis, muscular rheumatism, and partial paralysis. Some occupations are prone to induce a stoop in those who are engaged in them; thus it is, for instance, with watchmakers, engravers, embroiderers, writers, shoemakers, and others, whose occupations require a stooping position. This position, which is at first most irksome, becomes at length easy, and more or less permanent. Those, also, who are subject to asthma acquire a stoop which becomes diagnostic of the disease.

Debility is, in infancy especially, the cause of cyphosis. For the most part the curve occupies the entire length of the spine, from the occiput to the sacrum; and in infants this is the least severe form of posterior curvature. The normal curves of the spine have not been formed, the muscles of the back not having power to support the trunk; and the head consequently falls forward through muscular debility. This bowed condition of the spine increases, and the dorsal vertebræ become more prominent; for, notwithstanding its weakness, the child is seldom kept lying down. Nutrition is imperfect, and symptoms of rickets begin to show themselves; such as frequent diarrhœa, perspiration about the head and neck, general wasting, and a blanched condition of the skin.

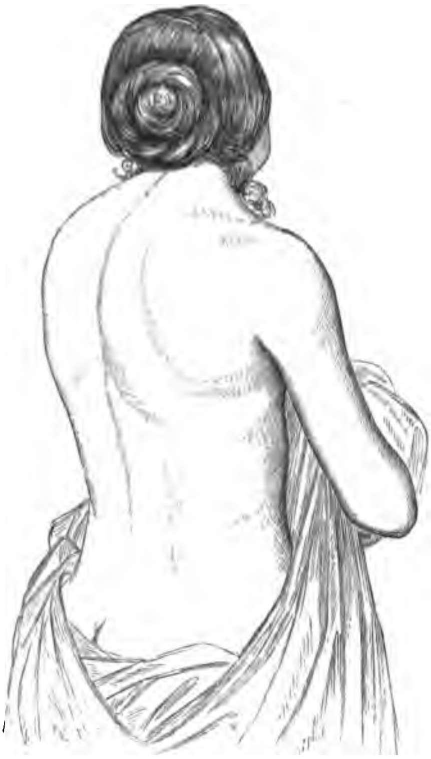
The child is uneasy and fretful. Swelling of the ends of the long bones may now be observed, especially of the carpal extremity of the radius and the tarsal end of the tibia; and the vertebræ will probably now assume a somewhat more prominent appearance.

Such children are seldom brought up at the mother's breast, or they are not alone nursed, but at the same time they are fed with farinaceous food. Some are born rickety; others become so at the breast, when, at the same time, they are fed with farinaceous food; but a child which is healthy at birth will seldom show symptoms of rickets while it has a sufficiency of milk for nutrition (and without admixture of farinaceous food), and while it is kept warm.

Some of the worst forms of this affection are produced in Russia. The intense cold which prevails during the winter months is the reason, though an insufficient one, for the very imperfect ventilation which is observed in the dwelling-rooms throughout Russia. So badly ventilated and hot are the rooms in St. Petersburg, for the most part, that respiration is not carried on easily; but in winter the children are seldom allowed to breathe the outer air; and this is a prominent cause of the prevalence of this affection in Russia.

When the child has commenced to walk, a different kind of curve is, for the most part, induced. Here the normal antero-posterior curves have been at least in part developed, that the erect position may be maintained, and consequently, as in the last-mentioned form of distortion, the curve which is induced is an exaggeration merely of the normal curve of the region. It occupies

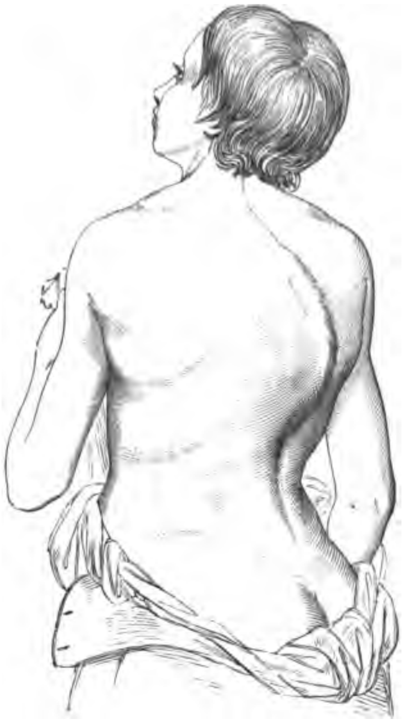
FIG. 6.



especially the middle or the middle and upper portions of the dorsal region, as is shown in Figure 6.

Occasionally, posterior curvature resembles angular curvature of the spine so closely as to be mistaken for it. In the instance from which Figure 7 was taken a rachitic tendency was hereditary; and, consequent on this condition, excessive distortion was induced, such, indeed, as I never saw equalled.

FIG. 7.



In *youth* posterior curvature often occurs during rapid growth, as a consequence of debility. At this period the lower cervical and upper dorsal vertebræ are mostly affected. A stoop is not unfrequently acquired during convalescence, which may remain permanent in manhood. Those also who are short-sighted, and who do not habitually wear glasses, are apt to accommodate their figures to their imperfect vision, and thus they acquire a stooping position. Posterior curvature is not attended with pain, so that firm pressure may be made along the course of the spine without flinching. Should, however, tenderness be found on examining the spine, destructive disease, or caries, must be suspected. Caries is often so insidious in its advances, that great and irremediable distortion may be already induced before the affection is recognized.

In *old age* an abnormal increase of the dorsal curve is common, as a result of muscular debility. Also, when cyphosis has been induced by any occupation, or through disease, as rheumatism, &c., it is frequently much increased in old age. Then equilibrium can no longer be sustained, and a stick becomes necessary for support.

Pathological Anatomy.

The pathological appearances differ according to the age at which cyphosis is observed. In infancy the muscular system is chiefly affected; while in the adult the intervertebral substances become compressed anteriorly; and in old age fusion of the bodies of the vertebræ, or more partial ossification, may be found. Together with these changes, the whole trunk is more or less affected; the chin rests on the sternum; the ribs are approximated, and respiration is laboured, in consequence of their diminished motion.

Treatment.

The treatment of this affection in childhood is simply to maintain the horizontal position until debility is so far removed that the child has power to sit or stand erect. Nature is an excellent guide with regard to this change.

When debility is inconsiderable, a splint of leather or gutta percha applied to the back will give sufficient support to enable such children to assume a sitting posture occasionally; but when the head droops, the horizontal posture ought to be maintained; for, otherwise, the head cannot be supported in an infant except by an apparatus. But such an apparatus being weighty is liable to do more harm than good. Children so affected, then, should be treated for debility in the horizontal position. It is unnecessary here, however, to dwell on the appropriate treatment for debility; this involves rules of diet and hygiene generally. It is a subject which deserves to be treated of at length; for it is one that is greatly neglected, and yet of the utmost importance to children of every class; since it relates to diet, the air that is breathed, the clothing by day and night, exercise, bathing, &c. I say it is of the utmost importance to children that these questions should be carefully considered with regard to them especially, since they are more sensitive to external agencies than adults; and yet no adult can neglect any of these considerations with impunity. The neglect of this subject involves great loss to the State; the lives of the people being shortened, and their physical power not being wholly developed through inattention to the laws of our well-being.

In the last chapter directions for constitutional treatment have been given which may equally be applied here. It will, therefore, only be necessary further to say that the horizontal position, together with a well regulated animal diet, attention to warmth, ventilation, exercise, bathing, &c., will speedily alter the appearance and increase the strength of any child suffering from cyphosis.

As the muscular system becomes more developed, gymnastic exercises are useful to increase the power of the extensors of the trunk. According to circumstances, they may be used in the horizontal or the upright position. These exercises will generally remove the tendency to cyphosis, if debility have occurred in youth, and they are employed carefully, and before the curve becomes permanent. In advocating the employment of gymnastic exercises, however, I consider it an absolute duty, having watched very closely their effects, to warn against their indiscriminate use. I know nothing more pregnant with danger where a spinal curve exists than the use of muscular exercises. They should never be undertaken without the constant superintendence of a competent person: frequently, a slight curve is increased by their use, and a temporary curve is rendered permanent.

Hereditary cyphosis will seldom be removed by any means; and it will generally recur if removed. It is, for the most part, conjoined with thoracic disease.

Portable instruments, which remove the weight of the head and shoulders from the spine, may be used with great advantage in most of these distortions; indeed, after childhood, they should, for the most part, be worn when exercise is taken; but modified pressure whilst in the horizontal position and on the spinal couch—pressure which can be regulated at will and perfectly adjusted by means of springs—is the only certain form of instrument which can be employed where the curve is more than of the slightest description. Severe pressure is not required in these cases; for the curve is readily removed by moderate, firm, pressure on the horizontal couch. Pressure which is painful is hurtful; it induces much rather a compensating curve than the removal of the primary curve.

In *old age*, support to the trunk may be so well adjusted that the instrument shall give great comfort to the wearer, and not be apparent, unless the head also be supported. These supports may be worn with the greatest ease, even on horseback. One of the most celebrated men that this country ever produced was, only some few years since, to be seen on horseback, with his chin very close upon the pommel of his saddle until he wore such a support as is now mentioned, when he was again almost as upright as in his youth. He continued to use this support so long as he rode; namely, until within a very short period of his last illness.

PATHOLOGICAL SPINAL CURVES.

SECTION III.

LATERAL CURVATURE OF THE SPINE.

General Description.

SCOLIOSIS, or lateral curvature of the spine, is that distortion in which the vertebræ deviate, as the term implies, in a lateral direction, from the mesial line of the trunk.

This affection may be divided into two stages, or periods; namely, first, *incipient curvature;* and secondly, *confirmed lateral curvature.*

It is important that these terms should be rightly understood; and I would, therefore, define them thus. Incipient curvature is that condition which is removable in the horizontal position, by slight lateral pressure; while a confirmed curve requires long-continued mechanical means to effect the same object.

Causes.

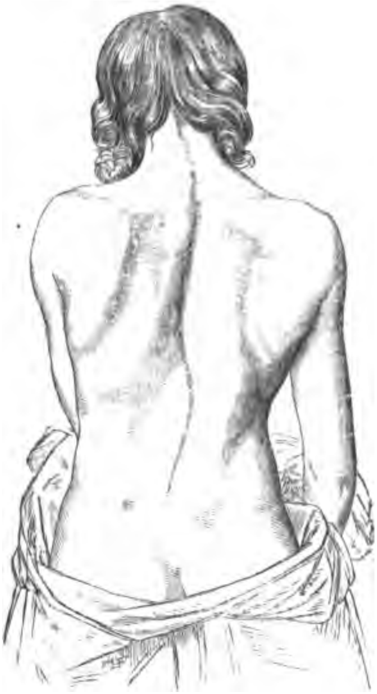
The causes of scoliosis are various. They are general and local debility, rickets, thoracic disease, obliquity of the pelvis, &c.

Debility is, without doubt, the most common cause of scoliosis. It shows itself in various ways. Thus, muscular debility during convalescence, and weakness of the ligaments during too rapid growth, give rise very frequently to this common affection.

Let us take, for instance, the case of a child whose health has been rendered delicate from whatever cause. If it be treated in the same manner as a stronger companion, some irregularity of form will probably develope itself; but the particular form of distortion will depend mainly on the habits of the child. For instance, if the child stand or walk much, it is probable that the internal lateral ligament of the knee-joint will yield, and give rise to genu valgum; and this distortion will probably be followed by yielding of the ligaments of the ankle-joint, and of those in the sole of the foot—valgus. Let us suppose, moreover, that in consequence of resting too much on one leg, as is very common with such children, the ligaments of that extremity have yielded more than those of the other. Virtually, that leg is shorter than the other; and, consequently, both feet resting on the ground, the pelvis necessarily becomes oblique to accommodate itself to the difference in length of the extremities. But an oblique pelvis must give rise to spinal curvature, as will be explained farther on.

Figure 8 was drawn from such a case.

FIG. 8.



The child was 12 years of age, and she habitually stood on the right leg.

The prominent features of the case may be thus described. Genu valgum was developed on the right side; the right side of the pelvis was, in consequence, lower than the left, which gave rise to a right lumbar curve, and a compensating left dorsal curve: the right shoulder was three fourths of an inch lower than the left, and the right side of the pelvis was half an inch lower than the left side.

FIG. 9.

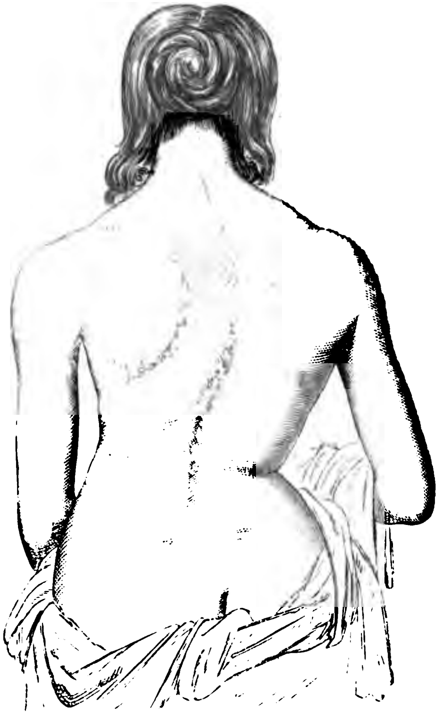


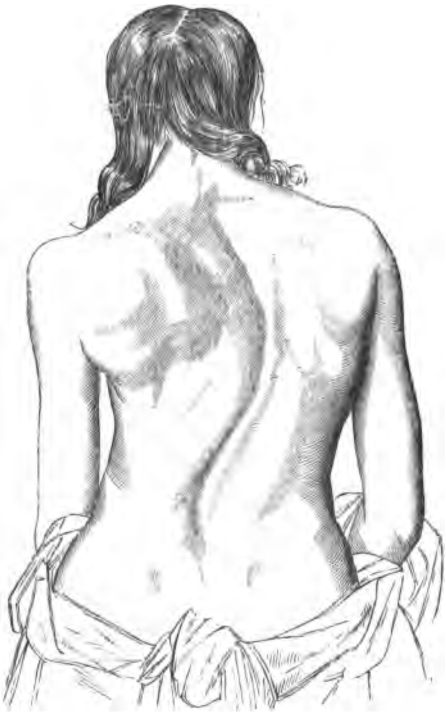
Figure 9 was taken from a young person, 16 years of age, who, from overgrowth, had become feeble. The spinal distortion had been four years in forming. She habitually stood on the right leg.

Both of these distortions, which are here represented in Figures 8 and 9, are due to debility. In the first, the internal lateral ligament of the knee-joint having yielded, and genu valgum having been induced, the pelvis became inclined towards the same side; and, as a necessary consequence, spinal curves—a primary lumbar and a consecutive dorsal curve—were formed. While in the second, Figure 9, from constantly standing on one leg the pelvis became oblique, falling towards the opposite side, as is well shown, and a lumbar curve was necessarily produced with its convexity towards the lowest ilium. This distortion was not at first, however, constant, but it might be removed in the horizontal posture—it was an incipient curvature which required time only, and a continuance of an evil habit to make it permanent. In the condition in which it is represented, however, the primary curve had become permanent, and it had given rise to a secondary, or dorsal curve. The existence of the secondary curve is a proof of the permanent character of the primary curve; for while the primary curve is incipient only, or removable in the horizontal posture, the secondary curve does not form; but the compensating curve commences to form so soon as the primary curve becomes in the slightest degree permanent.

Those who are feeble, whether from overgrowth or during convalescence, constantly change their position while standing; so that they rest for a short time only in one position and then change it for another—from both feet to one foot, for instance, and back again. And it is found that it is habitually the right foot in some cases, and in others the left foot, which has, in this way, to bear very frequently almost the entire weight of the body, until, at length, it becomes more natural to stand on one leg only, than fairly on both. It becomes so natural to do this, that it is done unconsciously; and until it is pointed out, the patient is frequently not aware of the habit. This occurred, and it was frequently pointed out, in the case from which Figure 9 was taken.

Debility alone does not usually give rise to lateral curvature of the spine; but there must be superadded bad habits of standing or sitting, which shall occasion obliquity of the pelvis and a primary lumbar curve. These habits to which I have alluded depend on debility, however; and therefore it is right to speak of debility as the cause of these distortions. But without obliquity of the pelvis, and therefore without bad habits of sitting or standing having been formed, lateral curvature of the spine may be occasioned by general debility. It may commence as a dorsal curve, as was the case with the patient from whom the following figure (Figure 10) was taken. This is a form of curvature which commonly begins during convalescence; and commencing as a dorsal curve, it shows that it does not depend primarily on obliquity of the pelvis, nor on any affection of the lower extremities.

FIG. 10.



Every distortion is produced by a special cause. It need scarcely be said that while the cause of curvature remains, the curve itself cannot be removed; or if it should be temporarily removed, it will certainly recur, inasmuch as the cause which first occasioned it still exists. This question of cause is one of the utmost importance, therefore, in the treatment of spinal curvature. It is greatly neglected, however, and misunderstood, so that with many the treatment of spinal curvature is simply to apply a spinal instrument, without reference to the cause of curvature. In some lectures which were lately published this is forcibly shown by the following opinion, which I am glad of this opportunity of adverting to and correcting. The writer says—"To the question, then, often put, which curve is the first in a case of double lateral curvature, the upper or the lower? the reply would be, the upper, inasmuch as it represents the remains of the primary sweep, extending the whole length of the vertebral column. For this explanation," he continues, "I am indebted to Mr. Tamplin."* This explanation is, however, entirely opposed to facts. If the curves were formed as is here represented, then lateral curvature might be treated without reference to cause by empirically applying a spinal support.

Scoliosis is sometimes hereditary. It is then due to rachitis, or to malformation of the spinal column itself, or to nervous irritation.

Paralysis of one side of the trunk always gives rise to lateral curvature of the spine, the healthy muscles drawing the spinal column away from the mesial line. The length of the curve will depend also on the extent and amount of paralysis: it may be a single curve,

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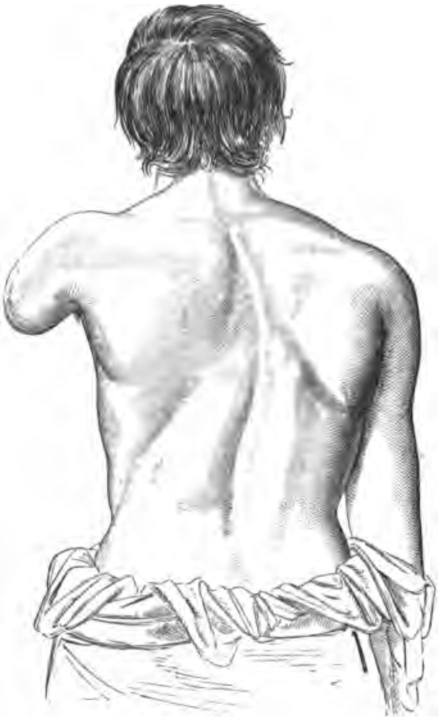
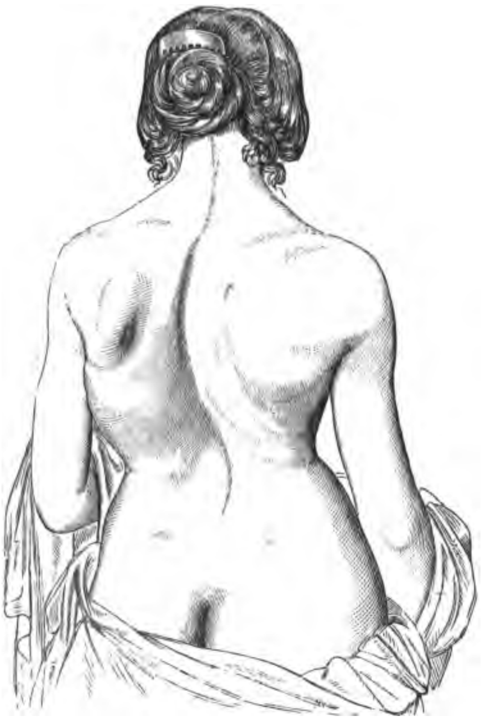
* 'British Medical Journal,' Feb., 1858.

FIG. 11.



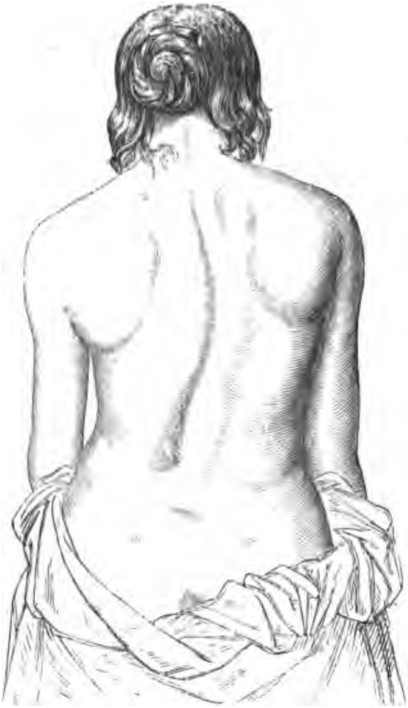
all the muscles of one side being paralysed; or it may be compensated by a second curve. After amputation of the arm, for instance, the muscles of the shoulder will necessarily become atrophic; and, in consequence, the opponent muscles exercising undue power on the spinal column, will curve it in the direction of their combined forces. Such, indeed, occurred in the case from which Figure 11 was taken. In this instance, however, the muscles were very powerful, and produced, consequently, more than the usual effect.

FIG. 12.



It has already been said that the particular form of distortion depends on the habits of the individual. Figure 12 was taken from a delicate young girl, sixteen years of age, who habitually carried a child on the left arm. This habit gave rise to a left dorsal curve, as is represented. And Figure 13 shows the reverse of this

Fig. 13.



distortion. Here, under similar circumstances, the right arm was habitually used for a similar purpose as in the last case.

Thus it is shown that, whether debility be local or general, lateral curvature of the spine may be induced equally, when the conditions are favourable to its production.

It is probably well known that the muscles of the back of those who wear stays are not red and firm, but that they are, for the most part, pale and weak, and even that they are atrophic and indistinct. Few will doubt that the constriction to which the figure is thus subjected conduces, through insufficient muscular development, to the formation of curvatures of the spine. It will, perhaps, be said, however, that debility of the muscles of the trunk being induced equally on both sides, there is no reason why lateral curvature of the spine should follow. It should be remembered, however, that the causes which act on the spine to induce curvature operate with increased force when the power of the muscles of the back is diminished.

It is stated by some, as Bühring, Hyrtl, and others, that the normal position of the spinal column is not absolutely in the median line of the body. If such were the case, nothing more would be required to explain how the use of stays should tend to increase this condition, and ultimately give rise to scoliosis. Dr. Little does not agree with Bühring as to the frequent original deviation of the spine, but "the examination of a number of adults and children unaffected with distortion, taken indiscriminately, has satisfied him that no obvious *natural* lateral curves, such as Bühring describes, are present in healthy persons."* Mr. Adams also entertains a similar opinion.

I have seen these measurements made by Bühring, and I willingly bear testimony to their accuracy. It is, besides, perhaps not more than might be expected, inasmuch as symmetry of form is the exception rather than the general law.

Both Bichât and Béclard have insisted strongly on the actions of the muscles in producing spinal curvature. It is only because those who have constantly worn stays are, for the most part, exempt from manual labour that confirmed lateral curvature is not much more frequently met with in this class than is at present the case. The effort to hold the spine erect is great in those who have discontinued the use of stays, and in these spinal curvature is readily induced.

Also, through the use chiefly of one arm, certain trades very commonly give rise to lateral curvature of the spine. Hence tailors, shoemakers, compositors, dressmakers, embroiderers, needlewomen, and others, are especially prone to this distortion. But perhaps nurses who always carry the child on the same arm suffer more frequently from this distortion than any other of these classes.

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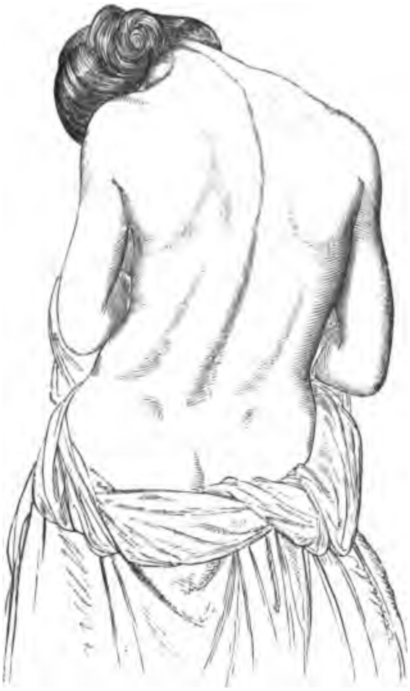
* 'Deformities of the Human Frame,' p. 368.

Again, *spasmodic action* of the muscles of the back, neck, and shoulder, occasionally gives rise to scoliosis. This is very rarely found to exist at birth, but it is occasionally met with, together with other manifestations of morbid action.

In the anencephalous and the hemicephalous infant every variety of distortion of trunk and limb is to be found. And in the same way distortions are seen, together with hydrocephalus and hydrorachis. Irritation is, however, for the most part much more limited in extent; and thus a set of muscles only may be retracted, as, for instances, in torticollis, talipes, strabismus, &c. These and other forms of muscular retraction exist, both as congenital and non-congenital distortions; they are each induced by a like cause, and they differ only in degree and form.

When the muscles of one side of the back are alone affected scoliosis results; but when both sides are affected lordosis is produced. Congenital curvatures are sometimes excessive in degree; so that the trunk may be reduced to two thirds of its normal height. Figure 14 was taken from one of the most remarkable cases of spasm that I remember to have witnessed. In this instance torticollis and scoliosis were induced to so great an extent, that it was difficult for the patient to remain upright; and, indeed, this position could only be maintained for a very short period.

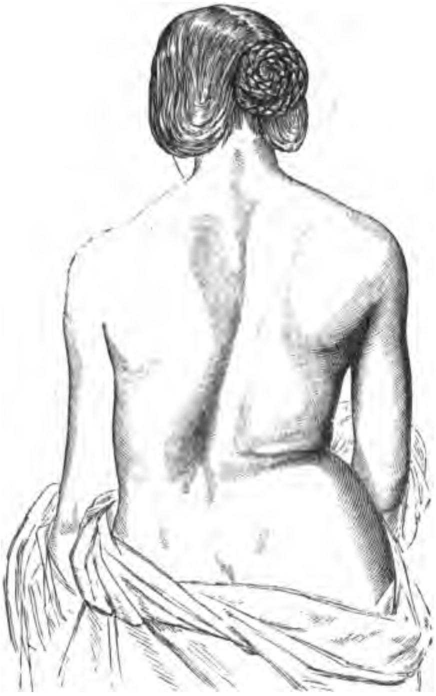
FIG. 14.



After some duration of spasmodic action, loss of power, partial or complete, may ensue.

Obliquity of the pelvis, however induced, whether by hip-joint disease, by rachitic curves of the tibia or femur, by genu valgum, or other cause, is a very common occasion of lateral curvature of the spine. It gives rise first to a lumbar curve, as is shown in Figure 15.

FIG. 15.



Rachitic curvature of the spine is not common. Rachitic disease of the long bones is a very common affection; but perhaps the spinal column is more rarely attacked by this disease than any other portion of the bony skeleton. When rachitic curvature is fully established the changes which take place in the vertebræ themselves, and the excessive distortion which is produced, render it impossible to restore the column to its normal condition.

This has been considered by some to be a common form of curvature; but the opinion involves an error and a serious error, inasmuch as the rachitic curve is of all others the most intractable. Mr. Tamplin says "it is by no means uncommon to find this rachitic state;" but, fortunately, he explains himself; for he continues thus: "associated with tubercular disease."* Now we know that these affections are rarely if ever met with together, and that they are even considered by pathologists as antagonistic. Such being the case, it is, happily, erroneous to suppose that "it is by no means uncommon to find this rachitic state associated with tubercular disease." As Sir B. Brodie says, "it was the prevailing opinion formerly, and I believe that some hold the opinion still, that the common cause of a lateral curvature of the spine is a rickety condition of the bones. This view of the pathology of the disease is not confirmed by the specimens preserved in museums of morbid anatomy, and no one who has seen much of these cases in the living person can doubt that the fact is otherwise. We are not, therefore, justified in regarding rickets as the common, or even as a frequent cause of spinal curvature: nevertheless it is the cause of it in a few instances."*

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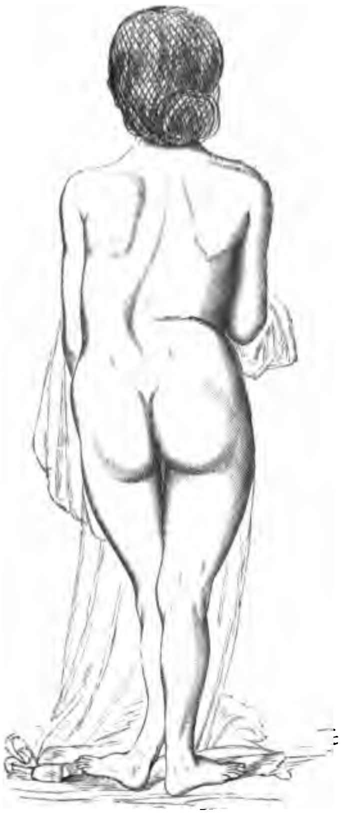
* 'On Lateral Curvature of the Spine,' p. 12. 1852.

FIG. 16.



The accompanying drawing (Figure 16) was taken from a patient, thirteen years of age, at St. George's Hospital, in whom, as well as in a younger sister, rickets were developed at eight years of age, involving in a terrible manner the lower extremities as well as the spine and the pelvis. Here the lower extremities were first implicated; then the pelvis, and lastly, the spine. The children were stunted in growth, and of remarkably unhealthy appearance; and the disease seemed to commence in them without known cause. Until eight years of age they had been as healthy as the rest of the family, when, without assignable cause, they were seized with this form of disease which gradually crept on. They were well cared for in every way and were lodged in Kensington Palace, the parents being servants attached to the Royal Family. Consequently it was difficult to account for this access of disease. Every circumstance appeared to be in favour of health. The accompanying figure is a good illustration of the rachitic curve.

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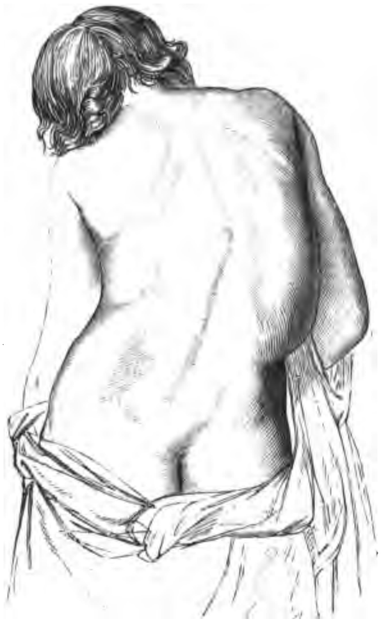
* 'Lectures.'

Increased or diminished capacity of either side of the thorax will occasion lateral curvature of the spine. As a result of inflammation, and after the removal of the effused fluid from the pleural cavity, the ribs sink to the compressed lung, the lung itself being bound down by adventitious membranes so that it cannot expand. The side becomes flattened, and the lung remains contracted. Compensation then follows, through amplification of the sound lung and enlargement of its containing cavity taking place. This form of lateral curvature is well shown in Figure 17.

FIG. 17.

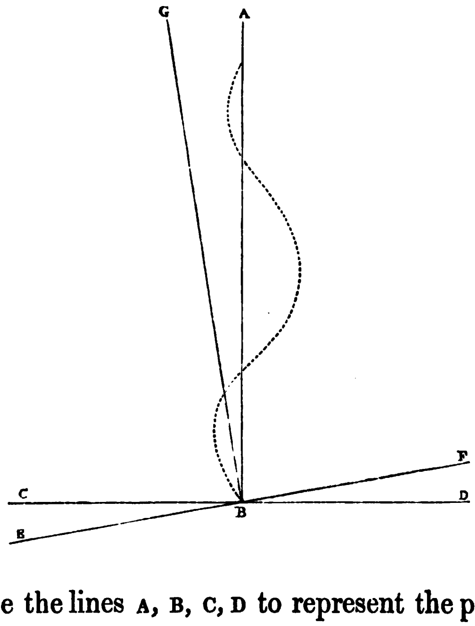


Again, *deficient development and excess of development of the bodies of the vertebræ* are among the rarer causes of spinal distortion. Examples of these are to be met with in some of our pathological museums. Also, caries of the bodies of the vertebræ occasions, perhaps, more frequently, and in a somewhat similar manner, a like result—a curve forming above and another below the seat of disease. It need scarcely be said that solid bony union must have taken place before lateral curvature is possible. Both of these conditions are rare, however.

Modes of Formation of Spinal Curves.

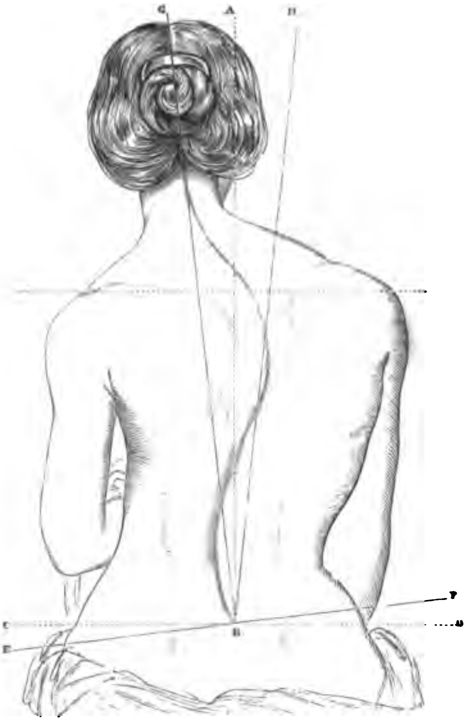
Perhaps the modes in which spinal curves are formed will be more readily understood by means of the following diagram (Figure 18):

FIG. 18.



Suppose the lines A, B, C, D to represent the pelvis and the spinal column in their normal relations; namely, the spinal column forming together with the pelvis a right angle. And let E F represent the pelvis rendered oblique, from whatever cause; and G B the inclined column still retaining a right angle together with its base. How is equilibrium to be maintained? It is manifest that the line G B, if continued, would render equilibrium impossible; and, therefore, a series of curves about the perpendicular line A B are formed to maintain equilibrium, as is better shown in the following figure.

FIG. 19.



It will be here seen, however, that the cervical curve corresponds to the line G B. Such must, indeed, more or less, be the case until equilibrium is being restored through increase of distortion; when the cervical curve approaches the perpendicular line A B, as is shown in Figures 18 and 20.

A primary curve may be either lumbar, dorsal, or cervical, depending on the cause which gives rise to it. Thus, a lumbar curve will be produced through hip-joint disease, and a cervical curve through torticollis; while through excessive use of an upper extremity a dorsal curve will certainly be formed as the primary curve.

No curve can remain single; but it is essential for equilibrium that, in every instance, secondary curves shall be formed, compensatory of the first; and thus, a series of curves is formed—two, three, or more—according to the severity of the primary curve, and to the period during which it has existed.

With regard to the formation of spinal curves, considerable errors exist. Thus, one author asserts that the lumbar curve is always the primary curve; while another, Pravaz, affirms with equal warmth that the dorsal must necessarily be first formed. Others (and it seems to be a prevailing opinion) teach that a spinal curve may remain single.

I trust, in speaking of the causes of spinal curvature, that I may have shown in such a manner as to carry conviction that the primary curve may be cervical, dorsal, or lumbar; and that equilibrium can only be maintained when compensating curves have been formed. A single curve can only exist in the horizontal position. Nothing more is necessary to produce compensating curves than the erect position, and the muscular force which is necessary to maintain that position.*

The curves are constantly undergoing change, becoming more and more compressed and rigid, until the height of the trunk is considerably diminished. As a necessary consequence, also, of this restoration of the equilibrium of the body, the obliquity of the hips and shoulders is always diminishing, until they again assume almost, if not entirely, a horizontal direction. This position is shown in Figure 20.

Symptoms and External Characters.

The symptoms of lateral curvature of the spine are so marked that it would be thought by some, perhaps, impossible to overlook a distortion where the gait and figure of the person proclaim the affection; and yet this distortion is constantly overlooked, or the awkward appearance is attributed to any but the right cause. Such was the case with the patient from whom Figure 9 was taken. This was an only and an orphan child, to whom her mother was entirely devoted. She was sixteen years of age; and the curves must have existed during at least four years; yet curvature of the spine was never suspected until one week before advice was sought. Then, during a visit to a relative, the distortion was pointed out. It will scarcely be credited, however, that curvature should not have been discovered in the patient from whom the next drawing was made, and that it had to be pointed out to the mother when it had arrived at the stage at which it is depicted in the following Figure.

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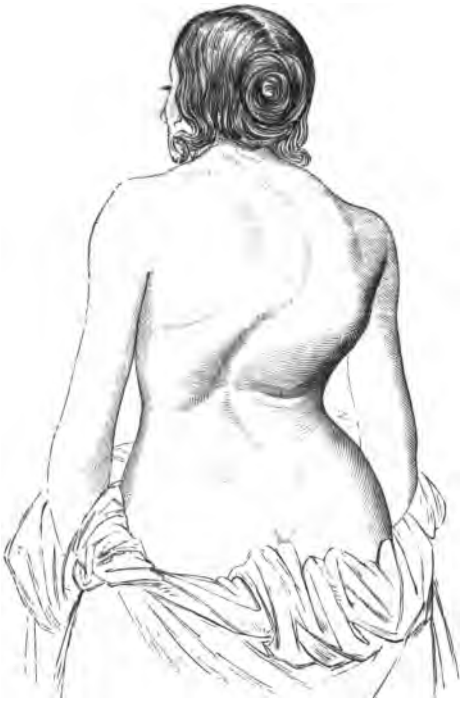
* One of the most severe dorsal curves that I have known was produced as a secondary curve and consequent on inflammatory retraction of the sterno-mastoid muscle. I saw this case with Mr. Mould. After division of the sterno-mastoid muscle and the removal of wry-neck, which had occasioned the dorsal curve, the spinal curvature was easily and almost simultaneously removed.

The external characters of scoliosis differ as much as the periods of development of the affection itself differ; and, consequently, they are not the same when curvature is incipient and when it is confirmed.

It has already been said that lateral curvature may be divided into incipient and confirmed curvature. Incipient curvature exists in the erect position of the body, and it may be removed in the horizontal posture. When, however, the curve becomes permanent, it is shown both by the form of the thorax and in the gait, as well as in the inequality in the height of the shoulders and the hips. The shoulders are no longer on the same plane; one is raised, while the other is depressed. The shoulder on the side of the dorsal convexity is not only unduly raised, but the scapula is rendered abnormally prominent, and its inferior angle is carried outwards and

FIG. 20.



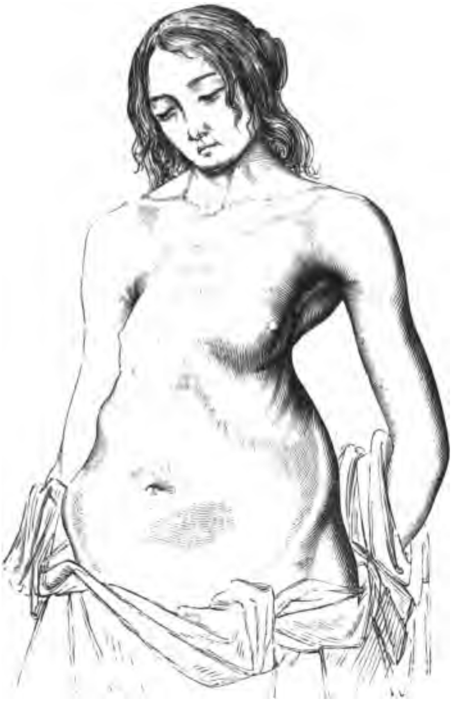
away from the median line of the trunk. But, while this occurs on the convexity, on the opposite side the scapula is depressed; for the ribs are flattened and depressed on the side of the concavity, while they are bowed out on the convexity. The scapula changes its position only as the ribs change in form; being raised and rendered prominent as these are bowed, and depressed as they are depressed.

This change in the form of the ribs is caused by rotation of the vertebræ; and thus it is that rotation of the vertebræ constitutes one of the most important characteristics of spinal curvature. It commences so soon as curvature becomes confirmed. Hence I have dealt with it as a means of classification; namely, thus: incipient curvature, or curvature without rotation of vertebræ; and confirmed curvature, or with rotation.

The angles of the ribs are rendered abnormally prominent on the side of the convexity of the curve; and the ribs themselves become more horizontal in direction, while they are separated more widely from each other than in their normal condition. On the side of the concavity on the other hand, the ribs are rendered more oblique in their direction and they are depressed, or even they overlap one another.

The anterior surface of the thorax also presents changes consonant with those which are going on elsewhere. All the changes are due to a common cause, and they proceed *pari passu.* On the side of the convexity, the ribs are flattened anteriorly; the mammary gland becomes atrophic, and its nipple presents outwardly; and the shoulder is raised and carried forward; while, on the side of the concavity, the ribs become unduly prominent. Thus the greatest diameter of the thorax is in an oblique direction from behind forwards. These particulars are shown in the following figure (Figure 21):

FIG. 21.



One of the earliest symptoms of spinal curvature is pain below the scapula, on the side of the convexity of the curve. This is not invariable, however. Not unfrequently pain is only felt when distortion becomes excessive. I have frequently observed this to be the case with hereditary distortions.

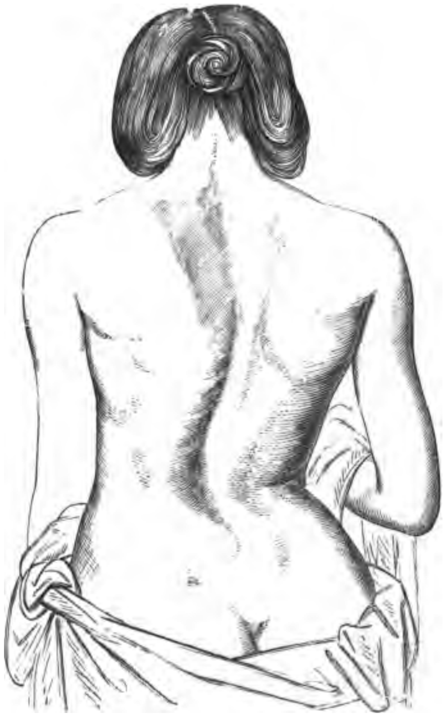
A symptom which always gains much attention is the prominence of one hip. The ilium on the side of the lumbar concavity is raised, and on the same side the loin sinks in so as to produce a striking alteration in the form; while on the opposite side—the lumbar convexity—the transverse processes project backwards through rotation of the vertebræ, and the spinal muscles are in consequence rendered prominent.

Pathological Anatomy.

It has already been stated that scoliosis is *incipient*, or *without rotation of the vertebræ;* and *confirmed*, or *with rotation.* In the former, the muscles are chiefly affected; but, in the latter, the ligaments and intervertebral cartilages are also much implicated. But, although the muscles, ligaments, intervertebral cartilages, and the vertebræ themselves, are implicated and altered in lateral curvature of the spine, these are not the only structures which are affected, for every viscus in the cavities of the thorax and abdomen is liable to become directly or indirectly involved through this distortion.

The *muscles* on both sides of the spine are, for the most part, somewhat more pallid than in their healthy condition. In the commencement of distortion, they are somewhat tense on the side of the convexity; in a more advanced stage, they become prominent through the projection of the transverse processes; and, at length, they become atrophic through disuse. In the concavity of the curve they are, for the most part, weak and relaxed—wholly inactive; yet I have known them to be so tense in the concavity of the curve, that they have formed the greatest impediment to the removal of distortion. It was so in the case from which the following figure was taken (Figure 22). In this instance, the ordinary treatment for spinal curvature proved ineffectual. It had been zealously pursued until the patience both of the patient and the surgeon had been exhausted, when it was determined to divide the erector spinæ. The operation was followed by the happiest result; the spine was speedily straightened, and it remained so. It is exceedingly rare, however, that such an operation is necessary, or that it is expedient to divide any muscular fibres. In France it has been done to a very great extent, but, as I believe, needlessly, and even to the injury of the patient.

FIG. 22.



The *ligaments* constitute a greater impediment to the removal of spinal curvature than the muscles. If, for the sake of experiment, the muscles be cut through, post mortem, it will be found that the spinal curve remains unaltered, or nearly so; but distortion may be removed by dividing the ligaments of the spine. These ligaments are shortened in the concavity of the curve, while they are elongated on the side of the convexity.

The *intervertebral cartilages* are compressed unequally, and consequently they become wedge-shaped, the thin edge of the wedge corresponding to the concavity of the curve.

It was shown in the first pages that the physiological spinal curves do not exist at birth, but that they are due to the erect position; and it was, moreover, shown that thinning of the intervertebral cartilages is due to unequal pressure. This compression is so great that a man of middle stature, who has maintained the upright position during the day, will be found to have lost nearly one inch in height. Such is the case with the normal—antero-posterior—curves. And, when lateral curvature takes place, a somewhat similar course is observed. A slight lateral curve is first formed: one shoulder sinks below the level of the other. The curve is not yet persistent, however, but it is again effaced after the horizontal position has been for some hours maintained; just as in the antero-posterior curves the height is restored after the recumbent position has been observed for some hours. At length, however, the lateral curve becomes permanent, the intervertebral cartilages remain compressed, and rotation of the vertebræ begins to take place.

FIG. 23.

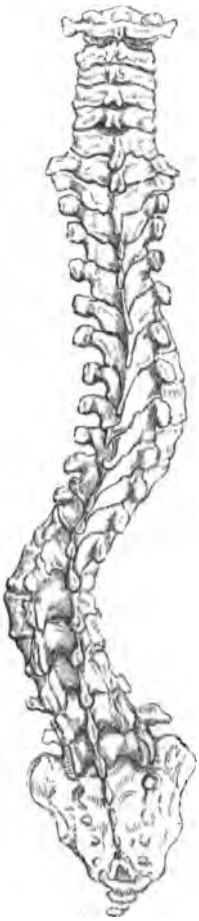
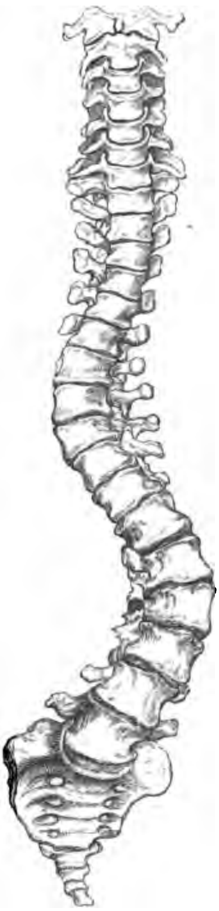
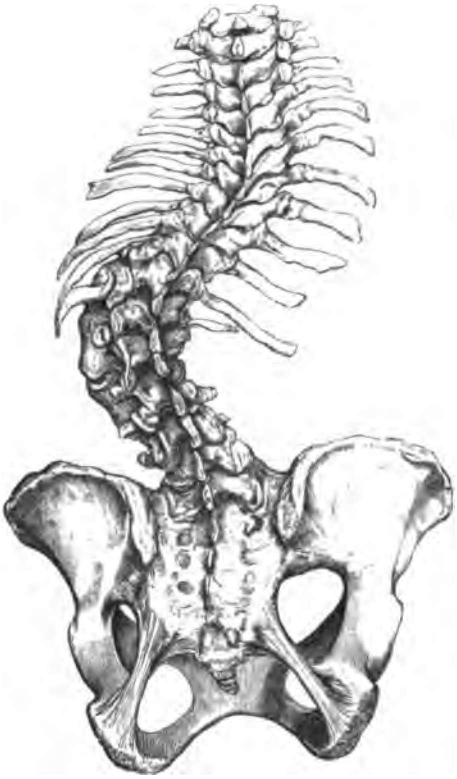


FIG. 24.



Rotation of the vertebræ on their vertical axes commences so soon as curvature becomes permanent, and it gives rise to a very curious formation of curves, the pathological characters of which have been for the most

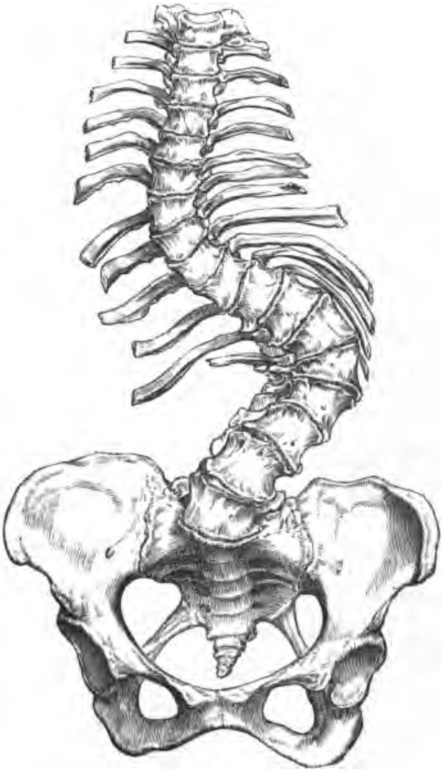
FIG. 25.



part overlooked. The posterior curves—those formed by the spinous processes, and the anterior curves, or those which are formed by the bodies of the vertebræ, are wholly different. Thus, in the specimen from which

Figure 23 is taken, the curve, judging from the spinous processes, might be thought to commence at the seventh

Fig. 26.



dorsal vertebra, and to terminate with the first lumbar; and it appears to be a single curve. Figure 24 represents, however, the bodies of the vertebræ from the same specimen. Here will be seen three well-marked curves;

namely, lumbar, lower dorsal, and upper dorsal. And in a second specimen, the difference between the anterior and the posterior curves is yet more remarkable, as is seen in Figures 25 and 26. In contrast to these are Figures 27 and 28, from an articulated spine, where the anterior and the posterior surfaces agree per-

FIG. 27.

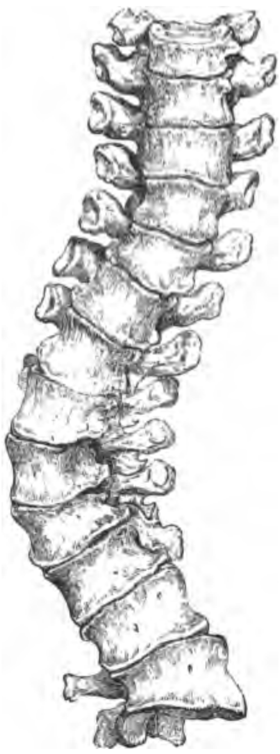
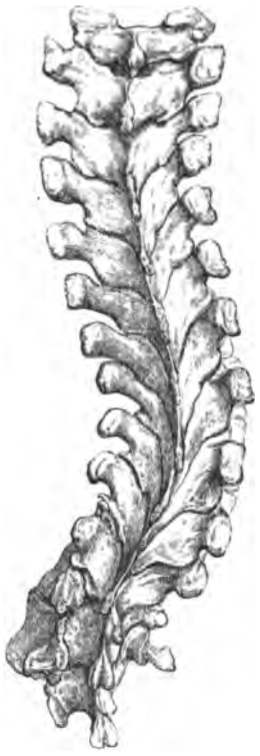


FIG. 28.



fectly; where the vertebræ are piled one above another with great care after the fancy of the constructor, but unfortunately without the slightest regard for truth. Such is the manner in which articulated spines are invariably put together. There is not, in the museum of the College of Surgeons even, an articulated spine where the characters of the distortion are preserved. It is only fair to say, however, that the vertebræ having been taken asunder, and the intervertebral cartilages having been removed, it is no ordinary puzzle to put the several parts together again as they had grown.

In the figures above (23 to 26) it will be seen how the bodies of the vertebræ are rotated towards the convexity of the curve, and how in the concavity the bodies, through pressure, become wedge-shaped; that vertebra which is the most central being also the most compressed —it may lose more than half of its thickness. It will further be seen that the spinous processes are not curved in the same manner as the bodies of the vertebræ; and that even in the lumbar region they describe a straight line, while the bodies themselves are immensely curved. Through pressure, the cancellous structure of the vertebræ becomes somewhat consolidated, and the outer surface of the bone is thickened and rendered more dense.

The mode in which curved spines are articulated in our museums tends to perpetuate an error. It is true that this spiral twist of the spinal column has been alluded to by several authors, but it is not understood that spinal curvature can exist without the apices of the spinous processes also describing a curve. Thus, many become hopelessly deformed through inattention to commencing distortion, and to the modes of formation of spinal curves.

This unequal pressure, which is caused by rotation, produces at length partial absorption of the intervertebral cartilages, as well as of the bodies of the vertebræ.

It is clear, from the previous statements, that, in defining a spinal curve, we should not be too rigidly guided in our judgment by the line of the spinous processes; but that the condition of the entire trunk should be considered. The line of the spinous processes is often such that, if it alone be considered, the diagnosis as well as the prognosis of the affection must be wrong.

The *transverse processes* of the lumbar vertebræ on the side of the convexity of the curve are rendered prominent, causing the erector spinæ to project; while, on the opposite side, the processes cannot be felt. And through rotation of the vertebræ, the articulating processes become partially absorbed by undue pressure, and their articular facets are lengthened.

But the most important result to the skeleton, of torsion of the spine, is the changed form and direction of the ribs.

The *ribs* necessarily follow in the altered direction of the vertebræ; they undergo, therefore, a movement of rotation backwards on the side of the convexity of the curve; their angles are rendered sharper, and the intercostal spaces become somewhat wider; while on the side of the concavity, the ribs are carried forward; they are depressed and flattened; and some of the intercostal spaces may in advanced distortion be effaced, the ribs overlapping one another. The capacity of the thorax is thus considerably diminished.

The scapulæ follow the course of the ribs; being raised on the side of the convexity, and depressed on the side of the concavity.

The *pelvis* is always rendered oblique by a lumbar curve. (See Figures 25 and 26.) This is the chief distortion of the pelvis consequent on lateral curvature of the spine. Other distortions of the pelvis are induced by rachitis; but obliquity is that which is especially observed together with scoliosis.

When, however, distortion of the spine is excessive, and it has been of long duration, slight flattening of the pelvis ensues, probably in consequence of the unequal transmission of the superincumbent weight. Thus, the ischium and the os pubis become somewhat flattened on that side on which the weight of the body is most thrown. This differs according to circumstances. Where both extremities are of the same length, in a straight line from the trochanter to the heel, the flattening will be found on that side on which the ilium is the highest—on the side of the concavity of the lumbar curve; but when difference in length of the extremities has given rise to curvature, such difference as is occasioned, for instance, by a rickety femur or tibia, by genu valgum or any other such cause, flattening will probably take place on the side of the shortest limb—the convexity of the lumbar curve. This flattening which occurs, except in a rickety pelvis, is slight; and, as far as the performance of functions is concerned, it is unimportant.

In addition to cervical, dorsal, and lumbar curves, the sacrum may be curved in a sense the reverse of the lumbar curve; and the ilium on the side of the sacral concavity is then carried forwards. The anterior superior spinous process of the ilium is thus inclined inwards and forwards, and the ischium and pubic bone of the same side are inclined inwards and backwards. These changes induce a slight narrowing of the pelvis. Also, through these changes, together with the torsion of the spine which has occurred, the promontory of the sacrum encroaches slightly on the pelvic cavity.

Distortion of the spine is never stationary, but it is always advancing slowly; until, at length, ankylosis takes place between the bodies of the vertebræ, and also between the articulating processes. Ankylosis may ensue after absorption of the cartilages, or it may occur through deposition of bone along the bodies of the vertebræ, in riband-like masses or in the form of nodosities—stud-like masses, connecting two or more vertebræ, without the previous removal of the intervertebral cartilages.

The *anterior surface of the thorax* presents changes which are scarcely less striking than those which have already been mentioned. Thus, on the side of the convexity, the ribs are flattened and depressed; and, together with them, the position of the mammary gland is changed: its position varies, being depressed from a quarter of an inch to an inch or more. This necessarily depends both on the situation of the curve and on its extent. The gland retains, if not entirely, almost its normal relation to the ribs, and is depressed together with them. On the side of the concavity of the thoracic curve, the ribs and cartilages become prominent; so that the projection is not unfrequently spoken of as a tumour. Sometimes pain is felt in this position; and I have more than once known this to be the only seat of pain in scoliosis. This prominence is occasioned through the rotation of the vertebræ, and the consequent thrusting forward of the ribs and their cartilages. These changes are shown in Figure 21.

The sternum also deviates somewhat from its normal position, its lower extremity being directed towards that side which is occupied by the convexity of the thoracic curve.

The *viscera* both of the thorax and the abdomen are compressed, and their functions become deranged in every severe form of lateral curvature of the spine. Such is the case, indeed, before distortion reaches its most severe stage. But the thoracic viscera suffer especially, being surrounded by bony walls. On examining the skeleton, one is apt to wonder how, in numerous instances, the functions of respiration and circulation can be carried on; so great is the change from the normal condition. The most prominent effects which are produced through compression are imperfect expansion of the lungs and condensation of their parenchyma, deficient aeration of the blood, and dilatation of the right side of the heart.

The aorta always follows the inflexions of the spine in scoliosis. Sometimes the curves which it describes are sharper, and sometimes they are less so, than those which are formed by the vertebræ. In severe scoliosis the aorta assumes curves so sharp as to interfere materially with the circulation of the blood. This is manifest in all cases where this distortion is seen in its worst forms. Specimen 3416 in the Museum of the College of Surgeons shows well these abnormal curves of the aorta.

Rachitic scoliosis seldom appears until disease is fully established in the long bones, and usually also in the pelvis. The nature of the affection can, therefore, rarely be doubtful. A rachitic tibia or femur, by inducing obliquity of the pelvis, may be the cause of spinal curvature. This is an every-day occurrence. The curve is not, however, therefore rachitic. Rachitic scoliosis and ordinary scoliosis have little in common but the existence of a curve and the compression of viscera consequent upon distortion.

Rachitic scoliosis commences in the bony structures. First, the periosteum becomes unusually vascular, tumid, and adherent to the bone. The structure of the bone itself is then somewhat swollen, and its vessels are filled with blood. The cells, too, of the spongy parts of the bones, and of the epiphyses of the long bones, become dilated and filled with sanguinolent fluid. Eventually, the cell-walls are broken down, and the medullary cavities become chambers filled with this fatty, sanguinolent, dark-coloured matter. This fluid is found both in the cavities of the bones and between the periosteum and the bone; and at length the bones become soft and cartilaginous, being, in part, deprived of their earthy constituents, so that they are easily cut with a knife, or as readily yield to pressure or to muscular force, and become misshapen. Wherever pressure is greatest, there is the most distortion. So in the spine it is found that the vertebræ which are most implicated in the curve are not only much compressed, but they are twisted on their axes, and through pressure become misshapen.

Through the weight of the trunk also, the pelvis is flattened and narrowed in its conjugate diameter; and this tendency to flattening is increased by the existence of lordosis, which, as a rule, exists together with scoliosis in rickets. The ribs on both sides of the thorax are flattened, and they are distorted into every conceivable shape.

To this softened and tumefied condition another even more important yet succeeds. The bony substance becomes more and more firm, the outer surface being hypertrophied and of ivory hardness; so that the distorted limb or spine, however misshapen, must so remain: change is impossible.

In no other form of spinal curvature does the pelvis become so distorted, as in that which is produced by rickets. The case of Isabel Redman will be remembered. I cite it as the most severe example with which I am acquainted, on record, of rachitic distortion of the pelvis. A ball one inch in diameter could not pass the brim of the pelvis. The Cæsarean section was performed on this patient by Dr. Hull.

Treatment.

The treatment of lateral curvature of the spine may well be divided into *preventive*, *curative*, and *palliative*.

The *preventive treatment* of lateral curvature of the spine comprises all those measures of hygiène which tend to the development of the body, and which conduce to its perfection. It relates, consequently, to food, clothing, bathing, exercise (bodily and mental), sleep, rest, &c.—to every circumstance, in fact, which may affect nutrition.

In youth, every care should be taken to strengthen the bones, to develop the muscles, and to promote activity of body—a system the reverse of that which prevails throughout England.

The freedom of action which is permitted to boys prevents them from suffering from affections of this nature. Lateral curvature of the spine is very rare among boys; and when it does occur, it arises generally from some affection of the lower extremities. But debility is the most common cause of distortion in young girls—debility which, one might almost say, is purposely induced, so different is their mode of life to that which seems to have been intended.

Exercise is essential to develop the muscular system; not only such regulated exercises as are comprised in a system of gymnastics, but freedom must be permitted in walking, running, playing, &c. This system has been introduced into some of the best schools in the neighbourhood of Paris, and with the happiest results. Nothing can exceed the appearance of health which prevails among the inmates. Widely different is it from that which may be observed in London schools, and, indeed, in schools throughout England. The use of forms and stays, and the want of adequate exercise, bathing, sleep, and rest, induce so much debility and consequent distortion, that it has been said, and with much truth, that it is difficult to find a young person so well developed as she ought to be, and that distortion is the rule rather than the exception in our female schools.

The *curative treatment* of curvatures of the spine comprises not only restoration to symmetry of form, but also such a development of muscular power as is necessary to that suppleness and activity of body which belong to health. The treatment may, therefore, be divided chiefly into two parts; namely, physical and dynamical, or constitutional and mechanical.

Constitutional treatment.—Those in whom lateral curvature is observed are, for the most part, feeble from birth; or general debility has been developed; or there is an hereditary tendency to spinal curvature. In all who enter into this class, and it is a very large class, there is either inherited or acquired weakness. It is required to give strength of body, together with a straight spine.

Doubtless, much may be done with this view; the digestive powers may be strengthened, the circulating fluids may be enriched, the respiratory organs may be placed under more healthy influences, than, for the most part, obtain in cases of this description.

Instead of hot and ill-ventilated rooms, the admission of pure air is to be encouraged. Exercise in the open air, sufficient for health and without fatigue, is essential to the re-establishment of health. To breathe the free air is not simply a luxury in these cases; but it is absolutely necessary for the prolongation of life and for the restoration of health.

It is of small advantage to remove disease if the patient is to be killed in the process; and yet there are those who, recommending the recumbent position, together with the use of instruments, to be observed unremittingly for years perhaps, do all in their power to impair digestion and every other function of the body to the utmost. In some affections, it is necessary that a recumbent posture shall be observed; but as it is a necessity, and the least of two evils, we must accept it. It is not so with lateral curvature of the spine.

It is of the utmost importance to consider the condition of the thoracic viscera in scoliosis, since muscular weakness and the form of the thorax prevent that free exercise of the lungs which is essential to health. But whenever a portion of the body ceases to perform its healthy functions, the approach of disease is to be feared. And, although phthisis is not common among those who are affected with lateral curvature of the spine, yet the recumbent position cannot be long maintained without imminent danger being incurred of becoming phthisical.

Sea-air and bathing are, in almost all cases of this description, highly to be recommended. The general health is thus improved; and with this improvement, the power to bear mechanical treatment increases. And, for the same reason, an animal diet, as much as possible, is to be encouraged. Cod-liver oil, also, may be given, together with preparations of iron, if a sufficiency of meat cannot be taken. Stimulants are only necessary to enable animal food to be digested more easily.

The *mechanical treatment* is that on which we chiefly rely for the removal of lateral curvature of the spine.

After what has been already said, it will not be doubted that the treatment of spinal curvature must vary as the cause which induced it varies. Unfortunately for orthopædic surgery, it has been too much the habit to treat every form of spinal curvature, whether induced by immoderate use of an upper extremity, or by deficient length of a lower extremity, or by thoracic disease, or other cause, after the same fashion; to ignore the cause, in fact, and to treat the affection entirely irrespective of cause and position; so that whether the curve be primary or consecutive—whether it depend on affection of a lower extremity, or on the use of an upper extremity—the dorsal curve is treated without reference to cause or consequences, until it has become matter of doubt, among members of the profession even, whether spinal curvature is curable.

Spinal curvature is curable; but only when all the circumstances which gave rise to it are taken into consideration.

Figure 8 represents a sigmoid curve which consists of a primary lumbar curve and a consecutive dorsal curve; and the cause of the lumbar curve is obliquity of the pelvis, occasioned by genu valgum. The ordinary treatment of such a case would consist of a spinal instrument to act on the convexity of the dorsal curve, with, perhaps, a second plate to act on the lumbar curve. Let no one suppose, however, that such treatment would be effectual to remove the spinal distortion. Not only would it not be removed, but distortion would, probably, increase, notwithstanding that the spinal instrument might be worn, so long as the cause remained. The treatment should first be directed to the cause of curvature; namely, to the knee; for, until the inversion of the knee is removed, the spinal distortion must remain. In this instance, the treatment was as follows. An apparatus was applied to the leg to restore the straight line of the limb; the recumbent position was much observed; and slight pressure was made on the lower part of the lumbar curve, while the dorsal curve was supported.

Again, Figure 9 illustrates a case in which the pelvis was rendered oblique through standing much on one foot, and where, consequently, a strongly marked lumbar curve was developed, which was compensated by a dorsal curve. In this instance, as in the last, it was necessary first to remove the cause by obliging the patient to recline in a spinal chair during several hours in the day. When this first point had been accomplished, the removal of the lumbar curve was easy; and, as would be expected, the dorsal, or compensating curve, was removed even before the primary curve. Thus, the recumbent posture must be considered a very important adjunct to other and more direct treatment, in all those cases which depend primarily on affections of the lower extremities.

Again, Figure 12 represents a case in which the dorsal curve had been induced by using inordinately the left arm in carrying a burden. The treatment was commenced by removing that burden; and a spinal instrument was then applied, so as to act on the lower portion of the convexity of the dorsal curve, as well as on the upper portion of the convexity of the lumbar curve. Subsequently, attention was given to the right shoulder, that the muscles, by suitable exercise, might be developed.

The cause of lateral curvature is rarely to be found in the spine itself. Generally, it must be sought for remotely; or the cause may be, and it often is, general debility, when the spine partakes with the rest of the organism.

Nothing has been more abused than the mechanical treatment of spinal curvature. Whether the case be curable or incurable, and whatever may have been the cause of distortion, the treatment in each instance has been the same. "Dans l'art de guérir, tout est bon, tout est mauvais; c'est un arme à deux tranchants—sublime si l'on s'en sert avec science, méthode, ordre, et sens commun; absurde et dangereuse autrement."

Common sense alone would indicate that, in the treatment of spinal curvature, the primary curve should first be acted on; and, further, that it is of little use to act on this primary curve without first attending to and removing the cause which gave rise to curvature.

Having, then, treated the cause, the question is, how best to act on the primary curve.

It has been shown how pathological spinal curves are formed, and that compensating curves are necessary for equilibrium. If the cause of curvature is removed, as genu valgum, for instance, the pelvis will regain its natural position; and the spinal curve, when distortion has been of short standing, may then be removed even without mechanical support of any kind. So long as the curve is incipient, it may be unnecessary to have recourse to a spinal apparatus; for well directed gymnastic exercises alternating with adequate rest may be sufficient to restore the spine. These measures may be relied on, except when a strongly marked hereditary tendency to lateral curvature exists. When such is the case, it becomes necessary in addition to the measures already alluded to, to apply mechanical support to the spine.

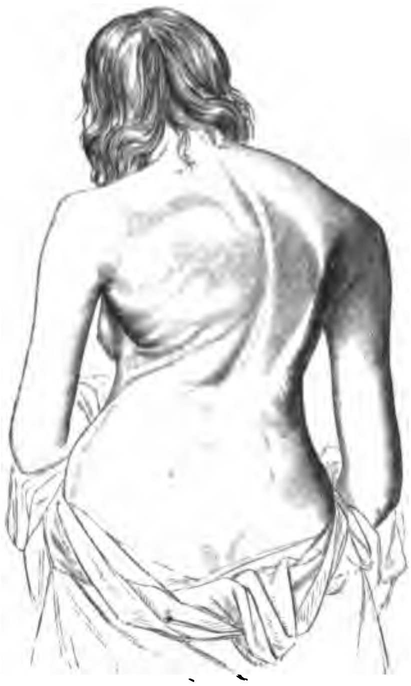
When, however, these measures are found not to be sufficient to arrest the progress of the affection, it is safer to have recourse to a spinal support without more delay. When curvature has become confirmed mechanical means are absolutely essential to remove the curve. And this having been determined on, it will scarcely be necessary further to insist that of a series of curves, the primary curve must first be acted on. Other curves which may be formed are merely compensatory of the first; so that to treat one of these, in lieu of the primary curve, is much the same as with disease to treat a symptom only.

It requires only a slight knowledge of mechanics to render it quite certain that in acting on a curve to remove it, pressure should not be made on the greatest convexity of the curve. Pressure in this position is quite unequal to remove a curve; it will flatten the ribs, but it will never lessen the spinal curve.

The effect of such pressure is shown in the following Figures (29 and 30). By dint of excessive pressure, the ribs were flattened, and the plates of the spinal instruments were entirely embedded in the ribs. It has never been my lot to witness anything more barbarous: irreparable distortion was produced. In each of these cases the treatment, such as it was, only tended to increase the distortion. This was proved by the casts which were taken from time to time.

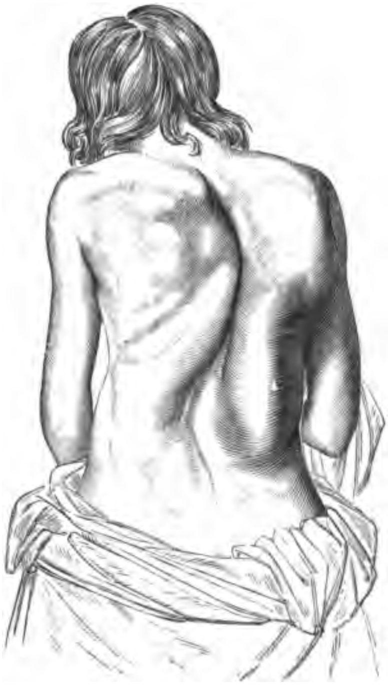
It is evident that such pressure as is necessary to be made should be so applied that it may produce the greatest effect in straightening the spine, with the least injury to those parts which are to be acted on. This may best be done by acting on the lower portion of the convexity of the primary curve obliquely upwards, and on the upper portion of the secondary curve obliquely downwards. This rule must be observed when the curves are formed from above downwards. But when they are formed from below upwards,—for instance, lumbar and dorsal, or lower dorsal and upper dorsal, &c.—it is necessary to act on the lower portion of each curve.

FIG. 29.



This pressure should, as much as possible, be made to follow the course of deviation of the parts themselves; and, consequently, it should never be directly lateral. By using extension in the manner indicated, curves, which cannot otherwise be treated, may be unfolded. This unfolding process is slow; and this will not excite surprise, when it is remembered what are the pathological changes which have taken place. Rapid effects are impossible, and should not be expected.

FIG. 30.



With regard to the effect of direct lateral pressure, the late Mr. Shaw said, "there can be little doubt that lateral pressure made upon the ribs when the spine is slightly bent, will tend to throw the sternum forwards, and thus to give the chest not only the form resembling that of a bird, but even of a fish." And again, "It is easy to demonstrate that the application of an instrument with this intent (lateral pressure), not only diminishes the area of the chest, but increases the distortion; for the shoulder is pressed against the flat part of the ribs, and, consequently, the unnatural angle, which, even in cases of slight distortion, is to a certain degree formed in the ribs is increased. When the ribs are thus distorted, the size of the chest is very much diminished, for the middle of the rib is necessarily brought nearer to the spine."*

Spinal instruments may be portable, or they may be fixed to a couch. When they are to be worn as portable instruments, they should be made as light as possible consistently with strength and utility.

When the general principle of construction is understood, the apparatus may be variously modified so as to act with the greatest advantage on the distortion whatever it may be. The pelvic band and lateral supports to receive the weight of the shoulders are always necessary; to which may be added two levers which may carry a shoulder sling to act on a cervical curve, and a plate for the dorsal curve; or it may be required to act on the dorsal and the lumbar curves at the same time, or even to increase the force of the dorsal plate by acting with a separate plate on the pelvis itself. The levers, or the plates themselves, may be provided with single or compound movements. By these means not only can the apparatus be adjusted very perfectly, and be made to fit with great nicety, but the power to overcome distortion is at the same time increased.

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* 'On the Distortions of the Spine,' pp. 65 and 120.

By means of adjustments the positions of the plates may be altered as the spinal curves are opened; and since the curves of the plates correspond in some measure to the curves of the ribs, and their obliquity is similar to that of the thorax itself, adjustment does not cause pressure directly in a lateral direction, but it occasions upward and downward pressure according to the nature and position of the curve to be acted on.

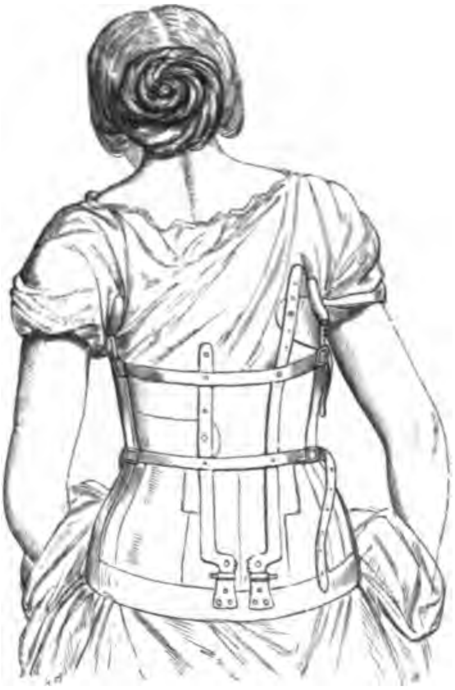
When the instrument fits well, frequent changes are unnecessary; great pressure is never required, and it may even be hurtful. Modifications, however, are necessary from time to time, to keep up the action of the instrument, and to vary the pressure as the curves unfold.

The form of spinal instrument which is usually required is shown in Figure 31.

In the treatment of these affections the patient should be permitted to recline in a spinal chair frequently during the day; and the instrument will then be worn with great comfort and advantage during the whole day.

But, although it is important that the spine should be well and efficiently supported, it is unnecessary that an apparatus should be worn at night. The restraint of an apparatus at night is injurious to health, and the instrument can never be worn so effectively that the body during sleep shall not be twisted in it.

FIG. 31.



But, without doubt, the most effectual mode of treating spinal curvature is on the spinal couch. In the recumbent posture the weight of the body is entirely removed from the spine, and the means, therefore, are necessarily much more efficient to remove distortion than when portable instruments alone are used. Not only is the recumbent position most favourable for the action of the instrument, but the instrument itself, when attached to the couch, is infinitely more powerful to remove spinal curvature than any portable instrument can possibly be. The principle on which both of these instruments are constructed is similar; but the couch, acting with powerful machinery, instead of a slight cog and pinion motion only, is so powerful to effect the purpose in view, that it will remove distortion in cases where the portable instrument is utterly useless. In cases of severe distortion, I always recommend the combined use of the couch and the portable instrument, the employment of one alternating with that of the other.

When spinal curvature has been produced by a local cause, or by an acquired habit, the cause must be removed and the habit must be overcome; without which it is impossible to treat this distortion effectively.

After curvature has been removed, attention should be directed to the development of power by means of exercises which shall bring into action the muscles of the trunk and extremities; such as swinging, dancing, riding, swimming, and the like. These exercises, alternating with rest, will, if judiciously employed, rapidly produce a marked increase of muscular power, as well as improvement in the general health. Friction also, as in shampooing, is very useful, not only in gaining a better condition of the skin, but it conduces to that suppleness of body which, after the removal of spinal curvature, is most difficult to acquire.

The *palliative treatment* of spinal curvature is applicable to such cases as are not curable. Figure 17 represents an instance of severe curvature, arising from inflammation within the thorax and its consequences. To attempt to cure such a case would produce fatal consequences: support to the shoulders and thorax is here alone admissible.

Again, when caries of the bodies of the vertebræ has occurred, lateral curvature not unfrequently follows above and below the seat of disease, after ankylosis has taken place. These curves are formed for the sake of equilibrium; and it will probably not often occur that the surgeon shall desire to disturb this effort of nature. I have seen, however, pressure with a spinal instrument made on such curves; the disease re-established; lumbar abscess form, &c. It need not be said here, that efficient support is all the instrumental treatment that ought to be permitted in such a case.

Cases also occur in which, through excessive distortion, rotation being very great, or ankylosis having taken place, cure is impossible; yet, where well adapted support gives to the patient not comfort only, but power. Without such support, there may be extreme weakness; but with it, strength may be given to follow the ordinary courses of life.

Such, then, is the course to be adopted in the treatment of the various forms and conditions in which spinal curvatures present themselves. Few subjects in surgery are perhaps less understood, and none are more abused, than this of curvatures of the spine. It is a subject full of interest, and one which is worthy of much attention.

THE END.

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